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## Scintillator Developments at Fermilab for New Generation Experiments

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Large new experiments are focusing on plastic scintillator for their detector design.

MATHUSLA, a proposed long-lived particle detector to be build near CMS at the LHC, plans to use scintillator as its active detector component. It foresees use of 1000+ tons of scintillator extrusions with WLS fiber readout into SIPMs. The spatial coordinate along the extrusion is formed by measuring the difference in arrival time of the light pulses from each end of the fiber. Optimizations include increasing the light yield of the extrusion and developing techniques to shorten the electrical pulse from the SIPM, including making faster WLS dopants and improving electrical pulse shaping.

The 3DST component of the DUNE near detector is a 3-D tracking detector based on ~1.5cm cubes of scintillator threaded with WLS fiber in the XYZ axes. Each “voxel” should be optically isolated from each other. The creation of the required 3M voxels requires advances in technology. We are developing procedures to injection mold the voxel with integrated fiber holes and co-molded opaque optical cladding. Another pressing issue is to improve the overall light yield of injection-molded scintillator. The existing state-of-the-art in scintillator injection-molding produces parts with low light yield (only 50% to 60% of that of commercial cast scintillator). We are working to optimize the formulations and the injection-molding process to increase the scintillation light yield.

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